Tourniquets, Dressings Change Battlefield Trauma Care

Story and photo by Karen Fleming-Michael
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When Dr. Tom Walters watches media reports from Iraq and Afghanistan, he listens for a key word: tourniquet. When he hears it five times in one weekend, like he did in June, he knows the work he's doing at the U.S. Army Institute of Surgical Research is making a difference to military personnel who might otherwise die from massive blood loss from an injured arm or leg.

Dr. Josh Wenke measures the pulse of Special Forces medic Sgt. 1st Class Dom Greydanus, who is tightening a tourniquet for a study at the U.S. Army Institute for Surgical Research in San Antonio. Researcher Dr. Tom Walters takes notes.

During World War II, tourniquets were frequently used, but fell out of favor with doctors who were treating evacuated patients, said Walters, a muscle physiologist.

"By the time they saw soldiers with tourniquets, the tourniquets had been on for a long time," which usually led to the limb being amputated, he said. "They [the doctors] had a real bias against them."

Tourniquets save lives

Two studies were key in changing attitudes about tourniquets when both came to the same conclusion: Seven to 10 percent of battlefield deaths in Vietnam and Somalia were caused by profusely bleeding arm or leg wounds, and if a tourniquet had been used, the service member would most likely have lived.

"This realization resulted in a real shift in people's attitudes, so they decided tourniquets weren't a bad thing at all, and in fact, everyone should have one and be taught to use it," Walters said.

Sgt. Christopher Haeusler, a medic with the 502nd Infantry Regiment, bucks the bias against using tourniquets when it came to treating wounded soldiers in Iraq.

"We come out of the schoolhouse being told that tourniquets are a last resort, but they're not. They save lives, and we should teach soldiers to use them and not to be afraid of them," he said.

In fact, Haeusler said, his platoon sergeant is alive today because one of Haeusler's soldiers used a tourniquet after the platoon sergeant was injured while riding a vehicle that was destroyed by an improvised explosive device.

Since hostilities began in Afghanistan and Iraq, Army researchers have tried to find the ultimate tourniquet for the warfighter. The cravat and stick tourniquet, which dates back to the late 1600s, is effective but takes precious minutes to apply.

"If you're shot in the main artery in the thigh—the femoral artery—you can easily lose a liter of blood a minute," Walters said. "It takes a trained medic about 4.4 minutes to apply the improvised tourniquet, and the human has about five liters of blood. That's one liter a minute, 4.4 minutes, and you only have five liters. You can do the math and figure out what the problem is."

Researchers have also examined the one-handed tourniquet. Fielded in 2002, it works well on arms but isn't as effective on muscular legs because the nylon tourniquet's one-inch strap isn't wide

enough to stop leg bleeding unless the user is extremely strong or tightens the strap with a stick or ratchet.

"There's an exponential relationship between the size of the limb and the amount of pressure that's required to stop blood," Walters said. "I'm a pretty skinny guy and have 20-inch legs, so it'll work on my leg. But my colleague who's an ex-football player and has 27-inch legs, there's no way it can work on him."

Testing to find the best

Then there are the other tourniquets that warfighters are buying online and taking into battle.

"It makes me anxious because they don't all work. Some are effective and some aren't, but nobody's exactly sure," said Walters, who regularly receives e-mail from surgeons in the field telling of the virtues and shortfalls of the commercial tourniquets they've seen in use. "We can't do anything about people going and buying tourniquets off the Internet."

What researchers can do is try to find the best tourniquet for the warfighter. This summer, 20 volunteers tested 10 commercial tourniquets sent in from companies around the country to the Institute of Surgical Research to see which work. Researchers completed the study in late July and have forwarded their recommendations to the military communities so they can use the best tourniquets in the field.

Finding the best tourniquet isn't a new idea, Walters said.

"You can go back and find writings from the Korean War when there were conferences where participants said 'What we need now is an easily accessible, fast-applied tourniquet,'" he said. "There's an unbelievable amount of frustration that this is even an issue. We feel that frustration, but it's also really important that we don't recommend anything until it's been tested."

New dressings further control bleeding

Finding the perfect tourniquet is just part of the solution for controlling gushing arm and leg wounds. The other part is using improved wound dressings that stop bleeding and let tourniquets come off.

Conventional medical doctrine as written right now says that once a tourniquet is used, only a medical officer can remove it. Because evacuations can take a while, the tourniquet could be left on for so long that the limb is permanently damaged.

Medical researchers want to see the doctrine change because capabilities have changed.

"Ideally, under fire or in the immediate situation, we will develop tourniquets and dressings to the point that a tourniquet can be applied as temporary vascular control, just to get the bleeding under control," said Dr. Anthony Pusateri, who works with hemostatic—blood-stopping—dressings and powders at the Institute of Surgical Research. "Then an advanced hemostatic dressing of some kind … gets placed on there and the tourniquet can come off."

Research results on tourniquets and advanced dressings have already prompted changes in battlefield medicine and civilian medicine. For instance, Special Operations forces have changed their doctrine to allow medics to use them, especially in conjunction with hemostatic dressings, and the American College of Surgeons Committee on Trauma has validated their use in the military environment.

"Because of the focused work in this arena by MRMC [U.S. Army Medical Research and Materiel Command] researchers and the DOD at large, the civilian EMS [emergency medical service] community is discussing the use of tourniquets as well," said Col. John Holcomb, commander of the Institute of Surgical Research.

For the military, "the big change in the doctrine is allowing medics to remove the tourniquet and switch to a less damaging wound dressing," Walters said, adding that current doctrine of only medical officers removing tourniquets dates back to World War II. "Having a tourniquet on for a couple hours is not going to result in the loss of a limb. There could be some weakness and some neurological problems, but they'll almost certainly be temporary."

FDA approval allows battlefield use

The Food and Drug Administration has approved two items that stop profuse bleeding. One is a dressing made from chitin found in shrimp shells; the other is a sand-like powder. Both are on today's battlefield, and both stop bleeding.

"In the past, when a tourniquet went on, there was nothing else out there, there was no other opportunity. You couldn't put a gauze dressing on there and hope that it would stop the bleeding," Pusateri said. "If you have severe bleeding that won't stop with standard direct pressure, or if you're under fire and there's nothing else you can do, a tourniquet can go on knowing that you're not risking that limb. Once there's an opportunity to provide care when you're not under fire, a hemostatic dressing can be applied."

Without the military's work on dressings that could control deadly hemorrhage, this potential change in battlefield medicine wouldn't be possible.

"Through the late 1990s, there weren't companies coming up with ideas that could make the quantum leap in hemorrhage control. The products were really to stop oozing bleeding a little bit faster," said Pusateri, who has worked with hemostatic dressings since 1995. "We don't need to stop bleeding that will stop on its own. We need to rapidly stop otherwise lethal hemorrhage."

New ideas proliferate

Pusateri said today, he receives at least a call a month about a new idea in controlling hemorrhage.

"The hemostatic dressings that are out there wouldn't be there if it weren't for the interest the Department of Defense has put into all the research over the years," he said.

Massively hemorrhaging limb injury is the number-one cause of preventable battlefield death, Walters said, but seeing getting tourniquets and hemorrhage control dressings to a battlefield can forever alter that statistic.

"The most important thing is the word is out that a lot of lives that were once lost to extremity hemorrhage can be saved by tourniquets—and people are using tourniquets," he said.

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